51. IWK
Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

PROCEEDINGS

11-15 September 2006

# FACULTY OF ELECTRICAL ENGINEERING AND INFORMATION SCIENCE

# INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING - DEVICES AND SYSTEMS, MATERIALS AND TECHNOLOGIES FOR THE FUTURE



TECHNISCHE UNIVERSITÄT
ILMENAU

**Impressum**

Herausgeber: Der Rektor der Technischen Universität Ilmenau
Univ.-Prof. Dr. rer. nat. habil. Peter Scharff

Redaktion: Referat Marketing und Studentische Angelegenheiten
Andrea Schneider

Fakultät für Elektrotechnik und Informationstechnik
Susanne Jakob
Dipl.-Ing. Helge Drumm

Redaktionsschluss: 07. Juli 2006

Technische Realisierung (CD-Rom-Ausgabe):
Institut für Medientechnik an der TU Ilmenau
Dipl.-Ing. Christian Weigel
Dipl.-Ing. Marco Albrecht
Dipl.-Ing. Helge Drumm

Technische Realisierung (Online-Ausgabe):
Universitätsbibliothek Ilmenau
ilmedia
Postfach 10 05 65
98684 Ilmenau

Verlag:
Verlag ISLE, Betriebsstätte des ISLE e.V.
Werner-von-Siemens-Str. 16
98693 Ilrnenau



ISBN (Druckausgabe): 3-938843-15-2
ISBN (CD-Rom-Ausgabe): 3-938843-16-0

Startseite / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=12391

51st Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
September 11 – 15, 2006

R. Klein

# Experiment on MHD turbulence under low magnetic Reynold's number

The work presents an experimental set-up concerning the investigation of the two way transition between 2D and 3D MHD turbulence in a rectangular box, filled with the liquid metal alloy GaInSn and under a strong magnetic field B. We discuss our eletric current source system, including strategies to avoid the well known technical problems, the basic construction of our turbulence-box as well as we present first measurement results of our high precesion signal processing system. Basically the design of our box is realized by a modular system, consisting of a teflon coated Cu-frame (inner side length 100mm) and several side plates containing the flow generating mechanism as well as the flow measurement techniques (Fig 1.). We first produce a homogeneous distributed 2D MHD turbulence by means of a constant electric current forcing over 100 uniform arranged Cu-electrodes on the bottom plate. We monitor the homogeneous distribution of the constant electric current by continuous voltage measurements over each of the 100 resistances (2 Ohm), which controls the Cu-electrodes/ GaInSn contact resistance. Depending on the amount of the constant electric current, injected through each electrode and the strength of the imposed constant magnetic field we will investigate the transtion to 3D MHD turbulence and compare the experimental results with our first theoretical predictions (Fig 2.). By means of two oscillating grids, facing each other and driven by a pneumatic/ hydraulic system, we first want to generate a 3D turbulent regime and characterize the transistion to 2D MHD turbulence for different strengths of the magnetic field and grid oscillation frequencies. Because the liquid metal is opaque we use the measurement techniques 'electric potential and ultrasonic doppler velocimetry' to determine the flow velocities. By real time measurements of the electric potential distribution on both Ha-walls with the same arrangement and number of 196 electric potential probes we are able to determine the velocity profile and their high frequency fluctuations as well as we can check the 2D/3D transition. Furthermore we present our signal processing system, which provides us measurements of small electric potential differences with a precision of 0,1μV (Fig 3.). With the additional installation of one 2D ultrasound probe on the top and several simple ones on the side plate we get low frequency 3D informations of the flow profile in a sufficient large volume in the middle of the turbulence box.

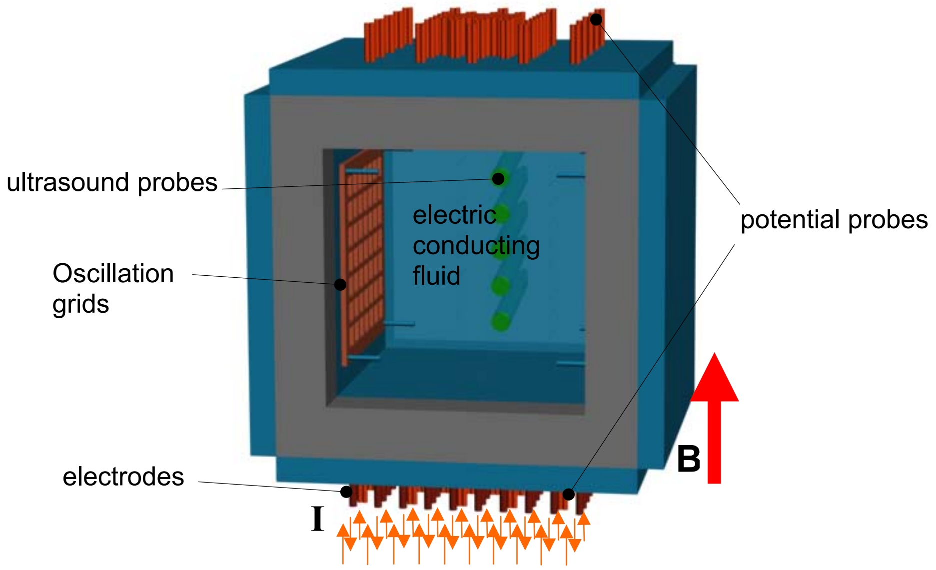


**Fig 1.** Modular experimental set-up of the turbulent box schematically with the turbulence generating mechanism and measurement techniques

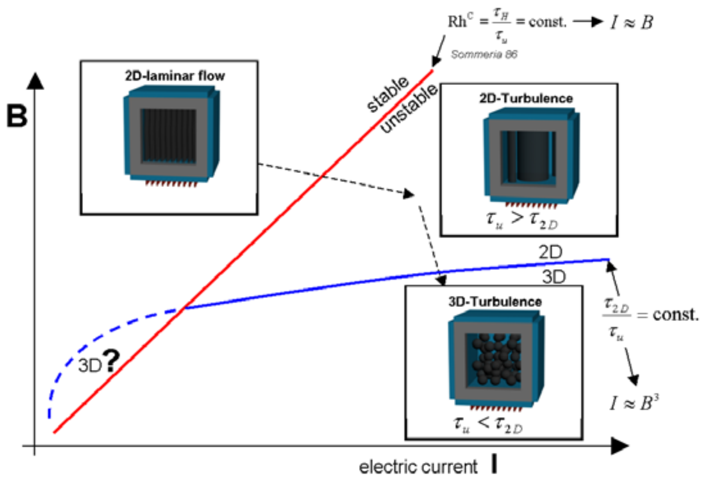


**Fig 2.** First approxiamtion transition mechanism-dimensional analysis (Assumption: $l_{\perp}$ (**B**,**I**) = const.)

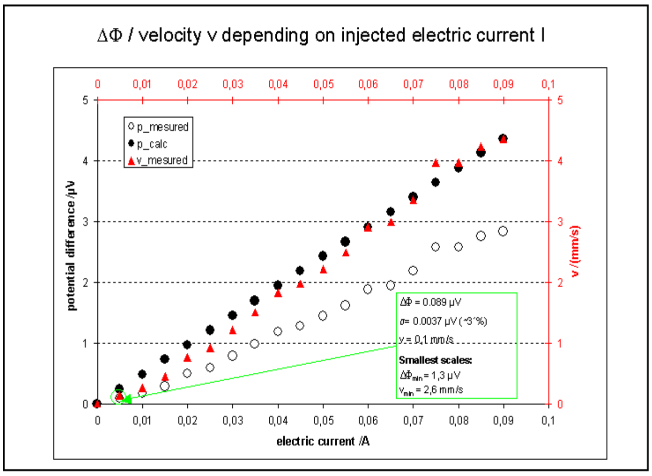


**Fig 3.** First measurement results of the high presicion (0,1 µV) signal processing system

**References:**


[1] J.Sommeria, *Experimental study of the two-dimensional inverse energy cascade in a square box* , J.Fluid Mech.(1986),


**Authors:**


Dipl.-Ing Rico Klein
Prof.Alban Potherat
TU Ilmenau, faculty of electrical engineering and information technology, electrothermal energy conversion division
98693 Ilmenau
Phone:03677/691509
Fax: 03677/69 1552
E-mail: rico.klein@tu-ilmenau.de